(13)

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-075340
(43)Date of publication of application : 26.03.1993

(51)Int.Cl. H01Q 21/22
H01Q 1/12
H01Q 13/08

(21)Application number : 03-235825
(22)Date of filing : 17.09.1991

(71)Applicant : HITACHI CHEM CO LTD
(72)Inventor : ISHIZAKA HIRONOBU
WAKUSHIMA SHIGETO
OTA MASAHIKO
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HAISHI MISAO

(54) BEAM TILT TYPE PLANE ANTENNA

CLAIMS

[Claim(s)]
[Claim 1] A beam tilt mold flat antenna to which the main beam direction which shows the maximum gain is characterized by being the range whose beam tilt angle is 42 degrees - 51 degrees in a beam tilt mold flat antenna in which only a beam tilt angle has a beam tilt function in which it was set up aslant, to the direction of a transverse plane of an antenna side.
[Claim 2] A beam tilt mold flat antenna according to claim 1 whose sense of a beam tilt angle is the direction of a single dimension.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the beam tilt mold flat antenna used for receiving antennas, such as satellite broadcasting service.
[0002]
[Description of the Prior Art] The direction 1 of the broadcasting satellite which the present broadcasting satellite BS-3a has in the advanced geostationary orbit of about 36,000km of equatorial skies with an east longitude of 110 degrees, for example, was seen from the Kanto district is thetaV= 38-degree zenith side horizontally from 180 degrees (south) of bearings at thetaH= 45-degree west side and a perpendicular, as shown by the system of coordinates of drawing 2 .
[0003] As a flat antenna which receives the electric wave from the conventional broadcasting satellite, as shown in drawing 3 (a) and (b), there is a beam tilt mold flat antenna 2 to which the main beam direction 3 which shows the maximum gain was aslant set only for beam tilt angle thetaT to the direction of a transverse plane of an antenna side. After rotating an antenna at the same plane as an attachment wall surface and doubling the main beam direction in the direction of a satellite about as a mounting arrangement of such a

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beam tilt mold flat antenna, the mounting arrangement which lessens the adjustment angle of an antenna is shown to JP,62-289001,A by by tuning whenever [to an attachment wall / champing-angle] finely.

[0004] Furthermore, with "1 construction of the beam tilt mold flat antenna for DBS" of television technical report RE'88-31 (Sep.1988), in the system of coordinates of drawing 2 , in order for a single dimension beam tilt method to realize the direction of a satellite, and the main beam direction which counters, it is shown that about 55 degrees beam tilt angle thetaT is required. As shown in drawing 4 (a) and (b), when beam tilt angle thetaT was made into 55 degrees and 180 degrees (south) of bearings are specifically assumed as bearing 4 of the attachment wall of the beam tilt mold flat antenna 2, antenna angle-of-rotation thetaR will be made into 50 degrees, and 3 degrees, then the main beam direction 3 will counter installation angle thetaS to the attachment wall of an antenna with the direction 1 of a broadcasting satellite.

[0005]

[Problem(s) to be Solved by the Invention] The installation conditions of the antenna shown in drawing 4 are conditions at the time of assuming that bearing of the attachment wall of an antenna is 180 degrees (south) of bearings to the last. On the other hand, on domestic housing conditions, the attachment wall of an antenna is not necessarily only the south face. For example, in order for beam tilt angle thetaT to receive satellite broadcasting service by the beam tilt mold flat antenna 2 which is 55 degrees when 225 degrees (southwest) of bearings are assumed as bearing 4 of the attachment wall of the beam tilt mold flat antenna 2 as shown in drawing 5 (a) and (b), it is necessary to make antenna angle-of-rotation thetaR into 16 degrees, and to make installation angle thetaS to the attachment wall of an antenna into 15 degrees. Thus, with the antenna whose beam tilt angle thetaT is 55 degrees, while the installation angle to an attachment wall becomes large, it will be in the installation condition of a negative angle, and will be in a very disadvantageous condition in respect of the effectiveness of an antenna.

[0006] conversely, in order to make installation angle thetaS to the attachment wall of an antenna into 0 degree by changing beam tilt angle thetaT Although it is required to be referred to as beam tilt angle thetaT which is different to bearing of an attachment wall, respectively as shown in a table 1, and it is necessary to carry out variety production of the antenna which has beam tilt angle thetaT corresponding to bearing of the attachment wall of each antenna It is not realistic to produce the antenna of such varieties.

[0007]

[A table 1]

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表1

壁の方位(°)	180 (南)	185	190	195	200	205	210	21
θ_T (°)	59	55	52	48	46	43	41	3
壁の方位(°)	230	235	240	245	250	255	260	26
θ_T (°)	38	39	41	43	46	48	52	5

[0008] This invention offers the beam tilt mold flat antenna which can be attached at a small installation angle to the attachment wall of 270 degrees (west) of 180 degrees (south) of bearings to bearings.
[0009]
[Means for Solving the Problem] The main beam direction where this invention shows the maximum gain offers [a beam tilt angle] a beam tilt mold flat antenna characterized by being the range which is 42 degrees - 51 degrees in a beam tilt mold flat antenna which has a beam tilt function in which only a beam tilt angle was set up aslant to the direction of a transverse plane of an antenna side.
[0010] After usually rotating an antenna at the same plane as an attachment wall surface and doubling the main beam direction in the direction of a satellite about, it tunes finely and a beam tilt mold flat antenna of this invention is attached so that the main beam direction may counter whenever [to an attachment wall of an antenna / champing-angle] in the direction of a satellite.
[0011] Here, as a location of a broadcasting satellite is shown by system of coordinates of drawing 2 , from 180 degrees (south) of bearings, horizontally, it is thetaV= 38-degree zenith side perpendicularly, and thetaH= 45-degree west side and a case where broadcast from this broadcasting satellite is received in the Kanto

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[0012] Since a beam tilt angle is the range which is 42 degrees - 51 degrees in a beam tilt mold flat antenna of this invention, it becomes possible to attach at a small installation angle (thetaS<=10 degree) to an attachment wall of 270 degrees (west) of 180 degrees (south) of bearings to bearings. That is, relation between beam tilt angle thetaT and installation angle thetaS to an attachment wall of an antenna comes to be shown in drawing 1 . Therefore, it becomes possible by making a beam tilt angle into the range of 42 degrees - 51 degrees to attach a beam tilt mold flat antenna at a small installation angle (thetaS<=10 degree) to an attachment wall.

[0013] It becomes [here / constituting / of an electric supply system / that it is only the direction of a single dimension instead of the direction of two dimension] easy as sense of a beam tilt angle and is desirable.

[0014] Moreover, it is desirable a comparatively good-looking polygon or to make it circular in the condition of having rotated since it installed in a wall surface as an appearance of an antenna where an antenna is rotated.

[0015] Although a case where satellite broadcasting service was received above in the Kanto district was explained, a beam tilt mold flat antenna of this invention can be installed in an attachment wall at an installation angle small enough in any district in Japan.

[0016]

[Function] Since the relation between beam tilt angle thetaT and installation angle thetaS to the attachment wall of an antenna is as being shown in drawing 1 when beam tilt angle thetaT of a beam tilt mold flat antenn is made into the range of 42 degrees - 51 degrees, installation angle thetaS to the attachment wall of an antenna becomes less than 10 degrees from 180 degrees (south) of bearings to a 270 degrees (west) attachment wall, and the stuck installation of it to an attachment wall is attained.

[0017]

[Example] the ground which consists of an aluminum board with a thickness of 1mm -- the microstrip substrate of 240x300mm of appearances which prepared copper foil with a thickness of 35 micrometers was used for the conductor through the dielectric layer with a specific inductive capacity [1.77] and a thickness of 0.8mm. this microstrip substrate top -- a rectangular patch mold circular wave radiating element -- in the direction of a tilt side, in 16 elements and the direction of a non-tilt side, a total of 256-element (16x16 elements) array was carried out, and the beam tilt mold flat antenna was manufactured in the pitch of 0.75lambda0 by [16] setting the amount of element setting phases of the direction of a tilt side as 150 degrees, and forming an electric supply system with the pitch of 0.6lambda0 (lambda 0: free space wave

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length of operating frequency).
[0018] Beam tilt angle thetaT was [45 degrees and the gain of the property of the manufactured beam tilt mold flat antenna] 26dB (40% of effectiveness). Moreover, as a result of connecting the low noise converter of NF1.0dB to this antenna and conducting a reception experiment in various places, it was as installation angle thetaS of an antenna to a 270-degree attachment wall being shown in a table 2 from 180 degrees of bearings in each installation.
[0019]
[A table 2]

表2 (単位：°)

取付壁の方位(°)		180(南)	190	200	210	240	250	260	270(西)
設置場所	札幌	5	0	5	9	9	5	0	5
	新潟	8	3	2	5	5	2	3	8
	東京	9	4	0	3	3	0	4	9
	大阪	9	4	1	2	2	1	4	9
	鹿児島	10	6	4	2	2	4	6	10

$\theta_T = 45°$

[0020]
[Effect of the Invention] According to the beam tilt mold flat antenna of this invention, since whenever [to the attachment wall of an antenna / champing-angle] can be stopped sufficiently small in a 270 degrees (west attachment wall from 180 degrees (south) of bearings, when simplification of fixing metal etc. is attained and it is further stuck by the wall, the effect of a wind, snow, etc. is also small and a housing fine sight is not spoiled, either.

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TECHNICAL FIELD

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PRIOR ART

[Description of the Prior Art] The direction 1 of the broadcasting satellite which the present broadcasting satellite BS-3a has in the advanced geostationary orbit of about 36,000km of equatorial skies with an east longitude of 110 degrees, for example, was seen from the Kanto district is thetaV= 38-degree zenith side horizontally from 180 degrees (south) of bearings at thetaH= 45-degree west side and a perpendicular, as shown by the system of coordinates of drawing 2 .

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[Translation done.]

OPERATION

[Function] Since the relation between beam tilt angle thetaT and installation angle thetaS to the attachment wall of an antenna is as being shown in drawing 1 when beam tilt angle thetaT of a beam tilt mold flat antenna is made into the range of 42 degrees - 51 degrees, installation angle thetaS to the attachment wall of an antenna becomes less than 10 degrees from 180 degrees (south) of bearings to a 270 degrees (west) attachment wall, and the stuck installation of it to an attachment wall is attained.

[Translation done.]

EXAMPLE

[Example] the ground which consists of an aluminum board with a thickness of 1mm -- the microstrip substrate of 240x300mm of appearances which prepared copper foil with a thickness of 35 micrometers was used for the conductor through the dielectric layer with a specific inductive capacity [1.77] and a thickness of 0.8mm. this microstrip substrate top -- a rectangular patch mold circular wave radiating element -- in the direction of a tilt side, in 16 elements and the direction of a non-tilt side, a total of 256-element (16x16 elements) array was carried out, and the beam tilt mold flat antenna was manufactured in the pitch of 0.75lambda0 by [16] setting the amount of element setting phases of the direction of a tilt side as 150 degrees, and forming an electric supply system with the pitch of 0.6lambda0 (lambda 0: free space wave length of operating frequency).
[0018] Beam tilt angle thetaT was [45 degrees and the gain of the property of the manufactured beam tilt mold flat antenna] 26dB (40% of effectiveness). Moreover, as a result of connecting the low noise converter of NF1.0dB to this antenna and conducting a reception experiment in various places, it was as installation angle thetaS of an antenna to a 270-degree attachment wall being shown in a table 2 from 180 degrees of

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bearings in each installation.

[0019]

[A table 2]

表2 (単位：°)

取付壁の方位(°)		180(南)	190	200	210	240	250	260	270(西)
設置場所	札幌	5	0	5	9	9	5	0	5
	新潟	8	3	2	5	5	2	3	8
	東京	9	4	0	3	3	0	4	9
	大阪	9	4	1	2	2	1	4	9
	鹿児島	10	6	4	2	2	4	6	10

$\theta_T = 45°$

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the graph which shows the relation between beam tilt angle thetaT in a beam tilt mold flat antenna, and installation angle thetaS to an attachment wall.

[Drawing 2] It is explanatory drawing showing the system of coordinates which show the direction of a broadcasting satellite.

[Drawing 3] It is explanatory drawing showing the main beam direction of a beam tilt mold flat antenna, and (a) is transverse-plane explanatory drawing and (b) is side explanatory drawing.

[Drawing 4] It is explanatory drawing showing the example of installation of the conventional beam tilt mold flat antenna, and (a) is strabism explanatory drawing and (b) is side explanatory drawing.

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[Drawing 5] It is explanatory drawing showing the example of installation of the conventional beam tilt mold flat antenna, and (a) is strabism explanatory drawing and (b) is side explanatory drawing.
[Description of Notations]
1 The Direction of Broadcasting Satellite
2 Beam Tilt Mold Flat Antenna
3 The Main Beam Direction
4 Bearing of Attachment Wall

[Translation done.]

DRAWINGS

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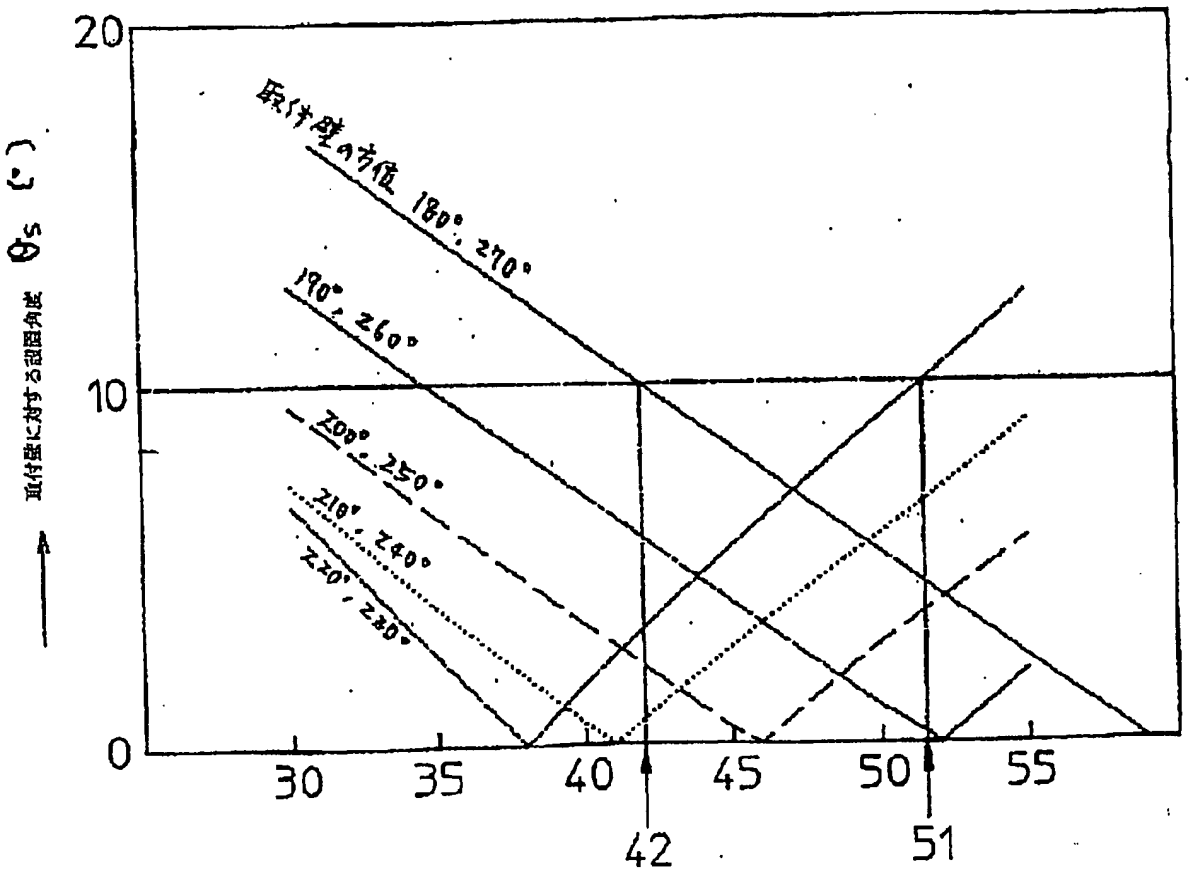
[Drawing 1]



[Drawing 2]

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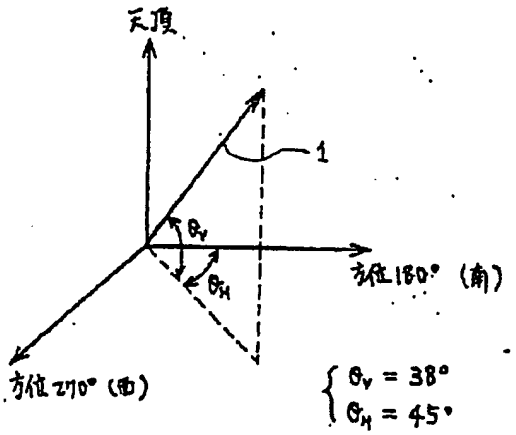

[Drawing 3]

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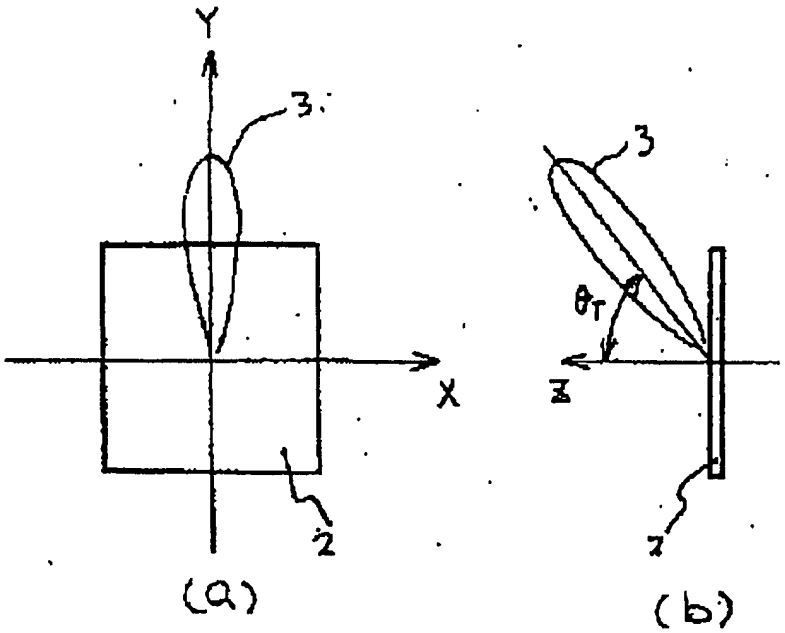

[Drawing 4]

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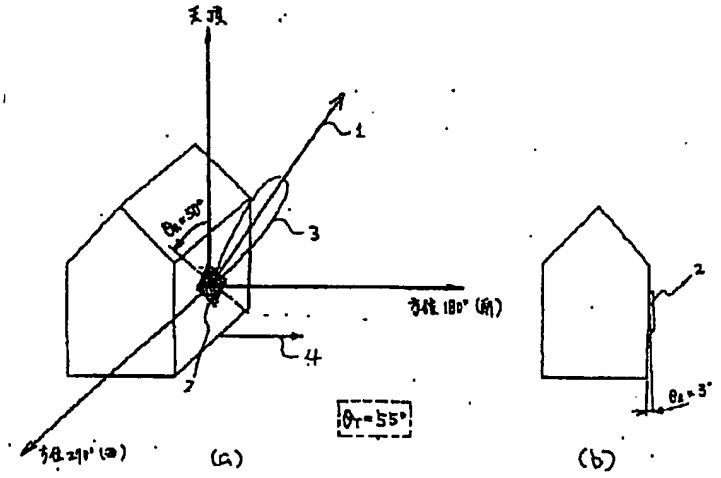

[Drawing 5]

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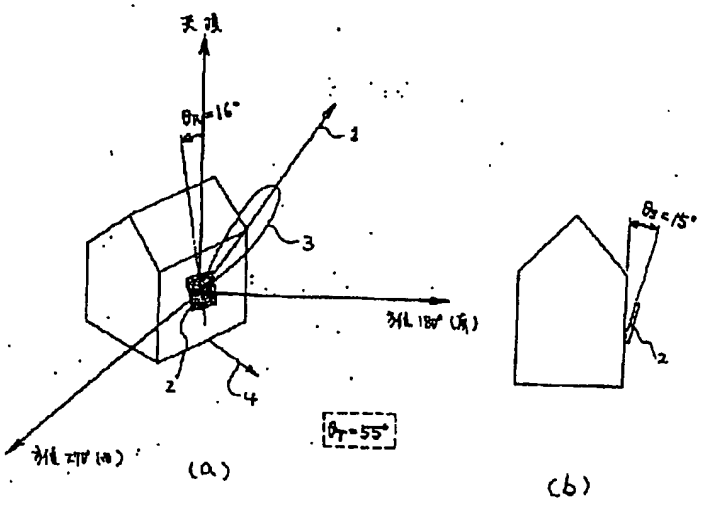

[Translation done.]

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